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National Institute of Environmental Health Sciences

The Science of Toxicology
What's out there? Why we need protection.

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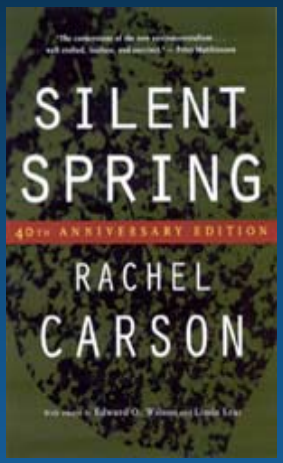
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
National Institutes of Health

Toxicology and the Environment
Rachel Carson and "Silent Spring"

- Rachel Louise Carson, 1907 – 1964, scientist and writer
- Published portions of her now historical book, "Silent Spring," in 1962
- Documented the effect of the pesticide DDT in the reproductive failure in various bird species.
- Raised compelling questions about the potential effects of similar industrial chemicals in humans.
- Started awareness of environmental impacts on human health that eventually prompted the establishment of NIEHS.



The National Institute of Environmental Health Sciences and National Toxicology Program

- In 1966, the National Institutes of Health (NIH) established the Division of Environmental Health Sciences located in the Research Triangle Park.
- The Division was elevated to the National Institute of Environmental Health Sciences (NIEHS) in 1969.
- The National Toxicology Program was established and headquartered at NIEHS in 1978 to conduct and coordinate toxicology studies within the Department of Health and Human Services.

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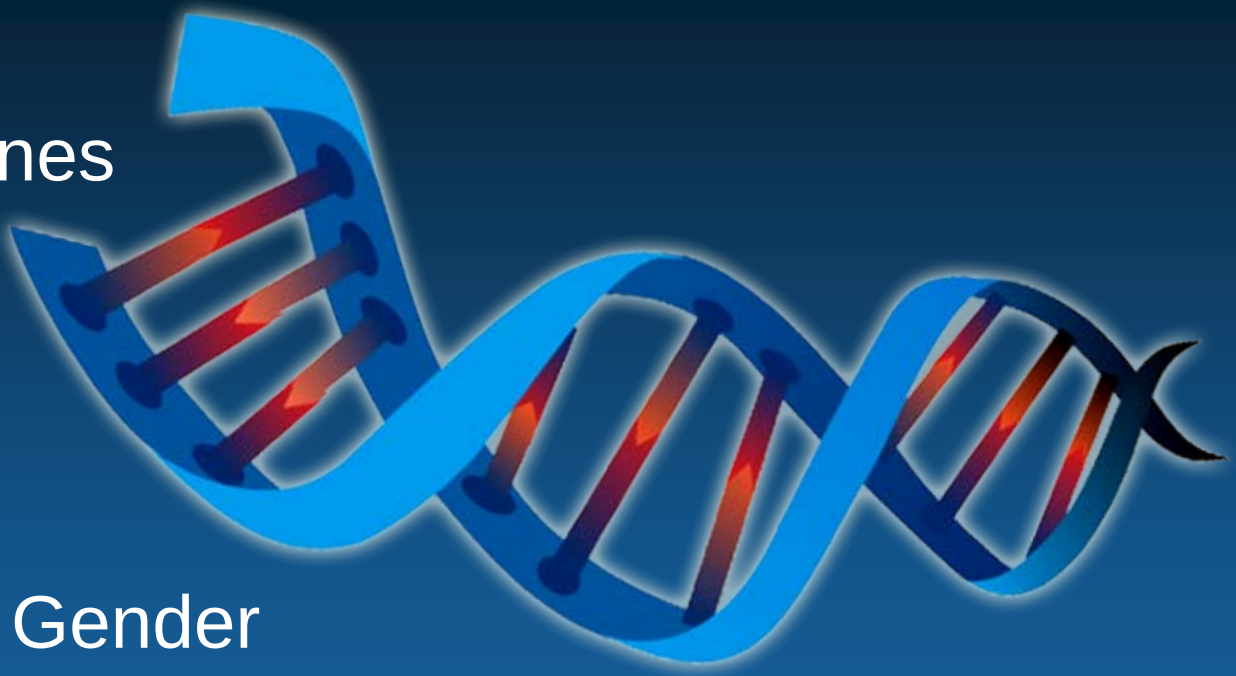
What Do We Mean by "Environment?"

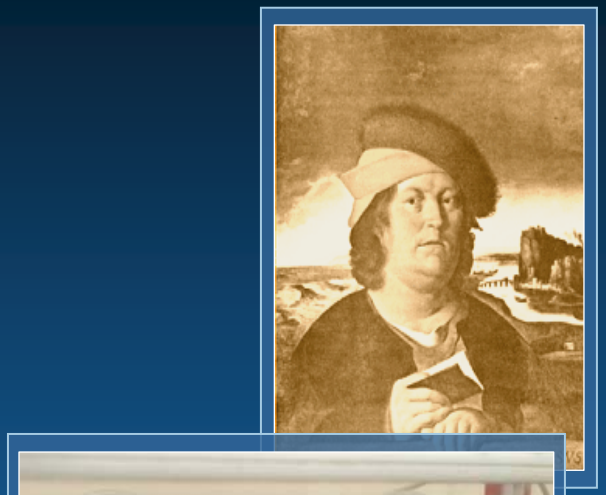
“Individual Susceptibility” is Controlled By:



Time Encompasses Both the Aging Process and the Timing of the Environmental Exposure

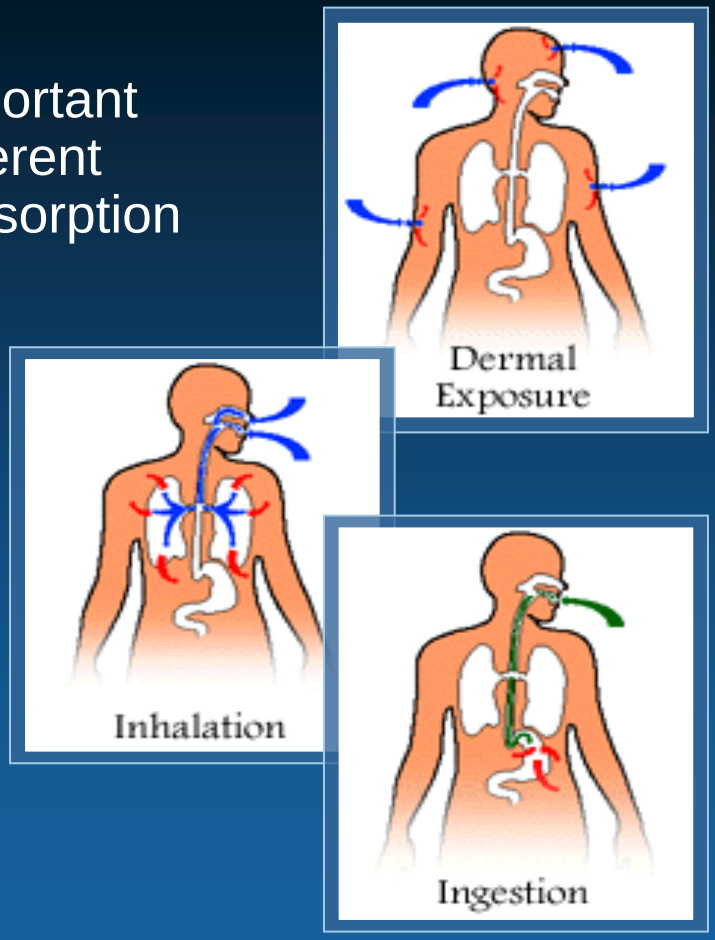
Toxicology: The Study of the Negative Effects of Chemicals on Living Organisms

- Paracelsus, Philippus Aureolus, 1493-1541, Swiss-born physician – "All things are poisonous, only the dose makes them non-poisonous." Dose is the key concept in Toxicology.
- Aspirin – beneficial dose 300-1,000 mg, toxic dose 1,000-30,000 mg
- Vitamin A – beneficial 5,000 units/day, toxic 50,000 units/day
- Oxygen – required 20% (Air), toxic 50% to 80%



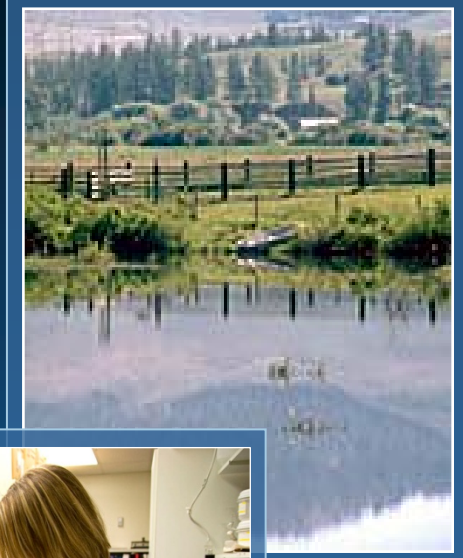
Route of Exposure

- The ROUTE (site) of exposure is an important determinant of the ultimate DOSE – different routes may result in different rates of absorption
  - Dermal (skin)
  - Inhalation (lung)
  - Oral (Ingestion)
  - Injection
- The ROUTE of exposure may be important if there are tissue-specific toxic responses
- Toxic effects may be local or systemic



Toxicity Testing

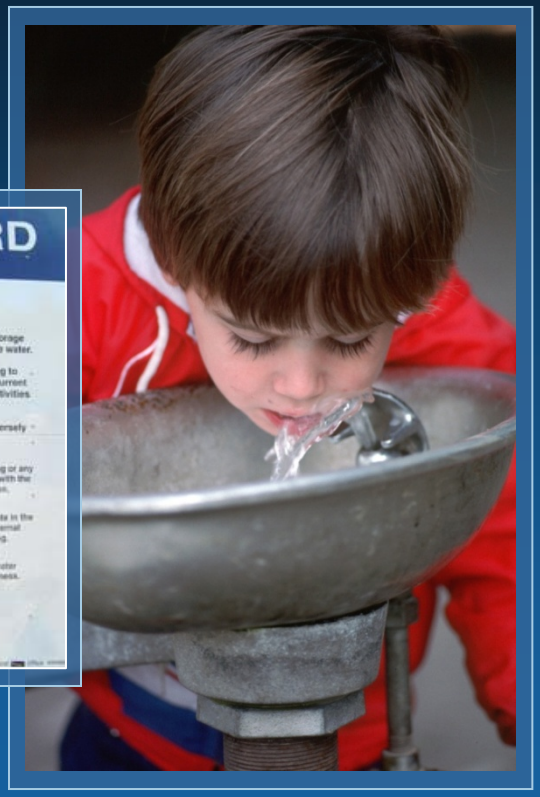
- Assesses the concentration-dependent hazard a chemical may present
  - Human health
  - Natural populations
- Results typically applied to
  - Approval of product use
  - Regulating allowable concentrations in the environment



Public Health Impact: Water Disinfection Byproducts

EPA will use NTP studies to help set drinking water standards

- Bromochloroacetic acid
- Bromodichloromethane
- Chloramine
- Chloroform
- Dibromoacetic acid
- Dibromoacetonitrile
- Dichloroacetic acid
- Sodium bromate
- Sodium chlorate
- Sodium chlorite
- Algal blooms



Some Environmental Agents That NIEHS Researched

- Lead – exposure to lead decreased after lead was eliminated from gasoline and paint, but continued research by NIEHS showed that lead exposure still occurred through old paint flaking and lead in soil and some consumer products
- Aflatoxin - a fungus found on crops in Africa and Asia, causes liver cancer
- Asbestos - NIEHS gave funds to Irving Selikoff at Mount Sinai Hospital in NYC, who showed that asbestos causes the cancer mesothelioma
- Air pollution – particulate matter and ozone were studied under NIEHS grants to Harvard University in the Six City Study, that later became the Twelve City Study, then the Twenty Four City Study, that served as one science base for the Clean Air Act
- PCBs - a liquid insulator used in electrical transformers and other applications, banned but still present in nearly all people and animals

Bisphenol A – A Chemical That Mimics Human Hormones

- Bisphenol A (BPA) is widely used to give plastics flexibility and is used in clear plastic water bottles, baby bottles, medical tubing and similar products.
- Because of its volume production and widespread use, it became the subject of studies and a workshop sponsored by the NIEHS Division of Extramural Research and Training, our grants division.
- The National Toxicology Program formed an expert panel to review studies on BPA through its Center for the Evaluation of Risks to Human Reproduction, identifying some concerns and finding no evidence for others.
- Meantime, manufacturers responded to the concern by discontinuing use of BPA in some products, such as making water bottles without this chemical.

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Environmental Estrogens and Endocrine Disruptors

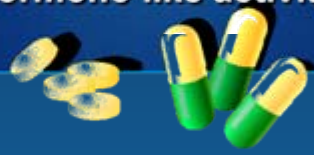
Soy products are used in infant formulas, soy flour, tofu, etc.

Supplements are added to feed for livestock (to increase rate of weight gain and improve feed efficiency).

Cosmetics and lotions contain phthalates that have hormone-like activity

Linings of metal food and drink cans and dental sealants have been reported to release Bisphenol A

Many drugs/pharmaceuticals and dietary supplements have hormone-like activity



Plasticizers and nonionic surfactants present in detergents contain alkylphenols; many persist in the environment

Pesticides are commonly used in the household and garden, as well as, for commercial and agricultural purposes; many pesticides persist in the environment.

NEWBOLD 2001

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The Sister Study – Seeking the Environmental Component in Breast Cancer

- The NIEHS Sister Study - 50,000 sisters of women with breast cancer who volunteer to provide a health history and ongoing health information as well as biological samples.
- The sisters are at a greater risk of breast cancer than the general population of women, but most will not get breast cancer.

THE SISTER STUDY
A Study of the Environmental and Genetic Risk Factors for Breast Cancer
National Institute of Environmental Health Sciences • National Institutes of Health • Department of Health and Human Services

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Asthma – Finding the Environmental Triggers

- CDC's National Health Survey has estimated that there are 22 million asthma sufferers in the U.S. - a major cause of school and work absences and emergency room visits
- NIEHS studies have identified roach and dust mite allergens as common triggers for asthma
- The studies have shown that inexpensive residential cleaning is effective in reducing asthma symptoms
- Also, mattress and pillow covers provide effective reduction to allergen exposure
- NIEHS funded studies have shown that living close to freeways increase asthma diagnoses in children
- A new on-site Clinical Unit will enhance NIEHS asthma research

Neurological Disorders and the Environment

- Neurological disorders such as autism, attention deficit hyperactivity disorder (ADHD), and adult onset diseases such as Parkinson's and Alzheimer's maybe rooted in early exposures to environmental toxicants
- Key neurotoxicants being studied are metals such as lead, mercury, and manganese; pesticides; tobacco smoke; polychlorinated biphenyls (PCBs) and polybromated diphenyl ethers (PBDEs) used to make insulating and flame retardant products
- NIEHS supports the Children's Center, UC Davis, in conducting the first large-scale human population study of children with autism

Environmental Health and Safety of Nanomaterials

- By 2015, the global nanotechnology market is projected to exceed $15 billion
- Nanotechnology could be useful for drug delivery systems, tissue engineering, biological and environmental sensor technology, and environmental remediation
- Safety assessment is challenging because of the diversity of materials used to synthesize nanoparticles as well as the wide range of physical and chemical properties that emerge at the nanoscale
- NIEHS aims to prevent health risks while guiding development of nano-enabled products

The National Toxicology Program
The Global "Gold Standard" in Toxicology Studies

- Studies include two-year two-species cancer studies as well as studies on reproductive, immunological, neuro and respiratory toxicology
- Executive Committee is made up of representatives of ten research and regulatory agencies
- NTP publishes the Congressionally mandated Report on Carcinogens that lists 246 probable and known carcinogens and gives detailed information on them

How Does NIEHS Get the Word Out on its Science?

- NIEHS has a heavily visited web site, www.niehs.nih.gov
- The NIEHS Office of Communications regularly distributes news releases highlighting and explaining Institute studies, and works to make scientists available to media reporters
- Institute researchers present their work at scientific meetings throughout the U.S. and often at international meetings, to supplement their wide publication in scientific journals
- NIEHS publishes the *Environmental Health Perspectives* journal which also has a web page, www.ehponline.org, which includes a Podcast, click on The Researcher's Perspective
- NIEHS has a longstanding program of Town Meetings co-sponsored by universities, locales, or advocacy groups, where senior scientific staff visits cities and towns throughout the country to present our programs and listen to environmental health concerns

Careers in Research

- Being a principal investigator who designs and conducts studies supported by younger scientists and technical and support staff, requires a doctoral level degree, most often a Ph.D. and/or M.D., or in some cases a DVM
- Support staff may have a bachelor's degree or a masters degree, and is hired for very specific skills, in technology, biological sciences or administration
- Most young scientists proceed through a doctoral program at a research university, followed by some years in a postdoctoral position prior to gaining a tenure track position with a university, NIH, other government organization, or another research institution
- Because science is very competitive, people often take opportunities with industry or other organizations as they adapt to a developing career. Adapting to your life experience is good

Careers in Research (cont.)

- Many “Alternative” Careers
  - Consulting
  - Communications
  - Advocacy
  - Politics

Your Turn – Questions?

- Asking questions is one of your most important jobs this summer

There are NO stupid questions!